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1 Claims

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3 1. Apparatus for generating a mist comprising:
4 a conduit having a mixing chamber and an exit;
5 a transport nozzle in fluid communication with
6 the said conduit, the transport nozzle being adapted
7 to introduce a transport fluid into the mixing
8 chamber;

9 a working nozzle positioned adjacent the
10 transport nozzle intermediate the transport nozzle
11 and the exit, the working nozzle being adapted to
12 introduce a working fluid into the mixing chamber;
13 characterised in that the transport nozzle
14 includes a convergent-divergent portion therein such
15 as in use to provide for the generation of high
16 velocity flow of the transport fluid;

17 and wherein the transport and working nozzles
18 have a relative angular orientation such that in use
19 the working fluid is atomised and a dispersed
20 droplet flow regime of droplets having a
21 substantially uniform size is created in the mixing
22 chamber by the introduction of transport fluid flow
23 from the transport nozzle into working fluid flow
24 from the working nozzle and the subsequent shearing
25 of the working fluid by the transport fluid.

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27 2. The apparatus of claim 1, wherein the transport
28 and/or working nozzle substantially circumscribes
29 the conduit.

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31 3. The apparatus of claim 1 or 2, wherein the
32 angular orientation and internal geometry of the

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1 transport and working nozzles is such that the size
2 of the working fluid droplets is less than 50µm.
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4 4. The apparatus of any preceding claim, wherein
5 the mixing chamber includes a converging portion.
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7 5. The apparatus of any of claims 1 to 3, wherein
8 the mixing chamber includes a diverging portion.
9

10 6. The apparatus of any preceding claim, wherein
11 the apparatus includes a second transport nozzle
12 being adapted to introduce further transport fluid
13 or a second transport fluid into the mixing chamber.
14

15 7. The apparatus of claim 7, wherein the second
16 transport nozzle is positioned nearer to the exit
17 than the working nozzle, such that the working
18 nozzle is intermediate both transport nozzles.
19

20 8. The apparatus of any preceding claim, wherein
21 the mixing chamber includes an inlet adapted to
22 introduce an inlet fluid into the mixing chamber,
23 the inlet being distal from the exit, the transport
24 and working nozzles being arranged intermediate the
25 inlet and exit.
26

27 9. The apparatus of any preceding claim, wherein
28 the apparatus includes a supplementary nozzle
29 arranged inside the transport nozzle and adapted to
30 introduce further transport fluid or a second
31 transport fluid into the mixing chamber.
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1 10. The apparatus of claim 9, wherein the
2 supplementary nozzle is arranged axially in the
3 mixing chamber.

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5 11. The apparatus of claim 9 or 10, wherein the
6 supplementary nozzle extends forward of the
7 transport nozzle.

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9 12. The apparatus of any of claims 9 to 11, wherein
10 the supplementary nozzle is shaped with a
11 convergent-divergent profile to provide supersonic
12 flow of the transport fluid which flows
13 therethrough.

14
15 13. The apparatus of any preceding claim, wherein
16 the transport nozzle is shaped such that the
17 transport fluid introduced into the mixing chamber
18 through the transport nozzle has a divergent or
19 convergent flow pattern.

20
21 14. The apparatus of claim 13, wherein the
22 transport nozzle has inner and outer surfaces each
23 being substantially frustoconical in shape.

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25 15. The apparatus of any preceding claim, wherein
26 the working nozzle is shaped such that working fluid
27 introduced into the mixing chamber through the
28 working nozzle has a convergent or divergent flow
29 pattern.

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1 16. The apparatus of claim 15, wherein the working
2 nozzle has inner and outer surfaces each being
3 substantially frustoconical in shape.
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5 17. The apparatus of any preceding claim, further
6 including control means adapted to control one or
7 more of droplet size, droplet distribution, spray
8 cone angle and projection distance.
9

10 18. The apparatus of any preceding claim, further
11 including control means to control one or more of
12 the flow rate, pressure, velocity, quality, and
13 temperature of the working or transport fluids.
14

15 19. The apparatus of claim 17 or claim 18, wherein
16 the control means includes means to control the
17 angular orientation and internal geometry of the
18 transport and working nozzles.
19

20 20. The apparatus of any of claims 17 to 19,
21 wherein the control means includes means to control
22 the internal geometry of at least part of the mixing
23 chamber or exit to vary it between convergent and
24 divergent.
25

26 21. The apparatus of any preceding claim, wherein
27 the internal geometry of the transport nozzles has
28 an area ratio, namely exit area to throat area, in
29 the range 1.75 to 15, having an included angle α
30 substantially equal to or less than 6 degrees for
31 supersonic flow and substantially equal to or less
32 than 12 degrees for sub-sonic flow.

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2 22. The apparatus of any preceding claim, wherein
3 the transport nozzle is oriented at an angle β of
4 between 0 to 30 degrees.

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6 23. The apparatus of any preceding claim, wherein
7 the mixing chamber is closed upstream of the
8 transport nozzle.

9

10 24. The apparatus of any preceding claim, wherein
11 the exit of the apparatus is provided with a cowl to
12 control the mist.

13

14 25. The apparatus of claim 24, wherein the cowl
15 comprises a plurality of separate sections arranged
16 radially, each section adapted to control and re-
17 direct a portion of the discharge of mist emerging
18 from the exit.

19

20 26. The apparatus of any preceding claim, wherein
21 the apparatus for generating a mist is located
22 within a further cowl.

23

24 27. The apparatus of any preceding claim, wherein
25 the conduit includes a passage.

26

27 28. The apparatus of any preceding claim, wherein
28 at least one of the passage, the transport
29 nozzle(s), working nozzle(s) and secondary nozzle(s)
30 has a turbulator to induce turbulence of the fluid
31 therethrough prior to the fluid being introduced
32 into the mixing chamber.

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29. A spray system comprising apparatus of any of claims 1 to 28 and transport fluid in the form of steam.

30. The spray system of claim 29, further including working fluid in the form of water.

31. The spray system of claim 29 or 30, further including a steam generator and water supply.

32. The spray system of claim 31, wherein the spray system is portable.

33. A method of generating a mist comprising the steps of:

introducing a flow of transport fluid into a mixing chamber through a transport nozzle;

introducing a flow of working fluid into the mixing chamber through a working nozzle located downstream of the transport nozzle;

generating a high velocity flow of the transport fluid by way of a convergent-divergent portion within the transport nozzle;

orienting the transport and working nozzles such that the high velocity transport fluid flow imparts a shearing force on the working fluid flow; and

atomising the working fluid and creating a dispersed droplet flow regime of droplets having a substantially uniform size under the shearing action of the working fluid on the transport fluid.

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34. The method of claim 33, wherein the apparatus is an apparatus according to any of claims 1 to 32.

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35. The method of claim 33 or 34, wherein the stream of transport fluid introduced into the mixing chamber is annular.

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36. The method of any of claims 33 to 35, wherein the working fluid droplets have a size less than 50µm.

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37. The method of any of claims 33 to 36, wherein the method includes the step of introducing the transport fluid into the mixing chamber in a continuous or discontinuous or intermittent or pulsed manner.

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38. The method of any of claims 33 to 37, wherein the method includes the step of introducing the transport fluid into the mixing chamber as a supersonic flow.

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39. The method of any of claims 33 to 38, wherein the method includes the step of introducing the working fluid into the mixing chamber in a continuous or discontinuous or intermittent or pulsed manner.

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40. The method of any of claims 33 to 39, wherein the method includes the step of introducing the

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1 transport fluid into the mixing chamber as a sub-
2 sonic flow.

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4 41. The method of any of claims 33 to 40, wherein
5 the mist is controlled by modulating at least one of
6 the following parameters:

7 the flow rate, pressure, velocity, quality
8 and/or temperature of the transport fluid;

9 the flow rate, pressure, velocity, quality
10 and/or temperature of the working fluid;

11 the flow rate, pressure, velocity, quality
12 and/or temperature of the inlet fluid;

13 the angular orientation of the transport and/or
14 working and/or secondary nozzle(s) of the apparatus;

15 the internal geometry of the transport and/or
16 working and/or secondary nozzle(s) of the apparatus;
17 and

18 the internal geometry, length and/or cross
19 section of the mixing chamber.

20
21 42. The method of any of claims 33 to 41, including
22 mixing the transport and working fluid together by
23 means of a high velocity transport fluid jet issuing
24 from the transport nozzle.

25
26 43. The method of any of claims 33 to 42, including
27 the generation of condensation shocks and/or
28 momentum transfer to provide suction within the
29 apparatus.

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1 44. The method of any of claims 33 to 43, including
2 inducing turbulence of the inlet fluid prior to it
3 being introduced into the mixing chamber.
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5 45. The method of any of claims 33 to 44, including
6 inducing turbulence of the working fluid prior to it
7 being introduced into the mixing chamber.
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9 46. The method of any of claims 33 to 45 including
10 inducing turbulence of the transport fluid prior to
11 it being introduced into the mixing chamber.
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13 47. The method of any of claims 33 to 46, wherein
14 the transport fluid is steam or an air/steam
15 mixture.
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17 48. The method of any of claims 33 to 47, wherein
18 the working fluid is water or a water-based liquid.
19

20 49. The method of any of claims 33 to 48, wherein
21 the mist is used for fire suppression.
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23 50. The method of any of claims 33 to 49, wherein
24 the mist is used for decontamination.
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26 51. The method of any of claims 33 to 50, wherein
27 the mist is used for gas scrubbing.